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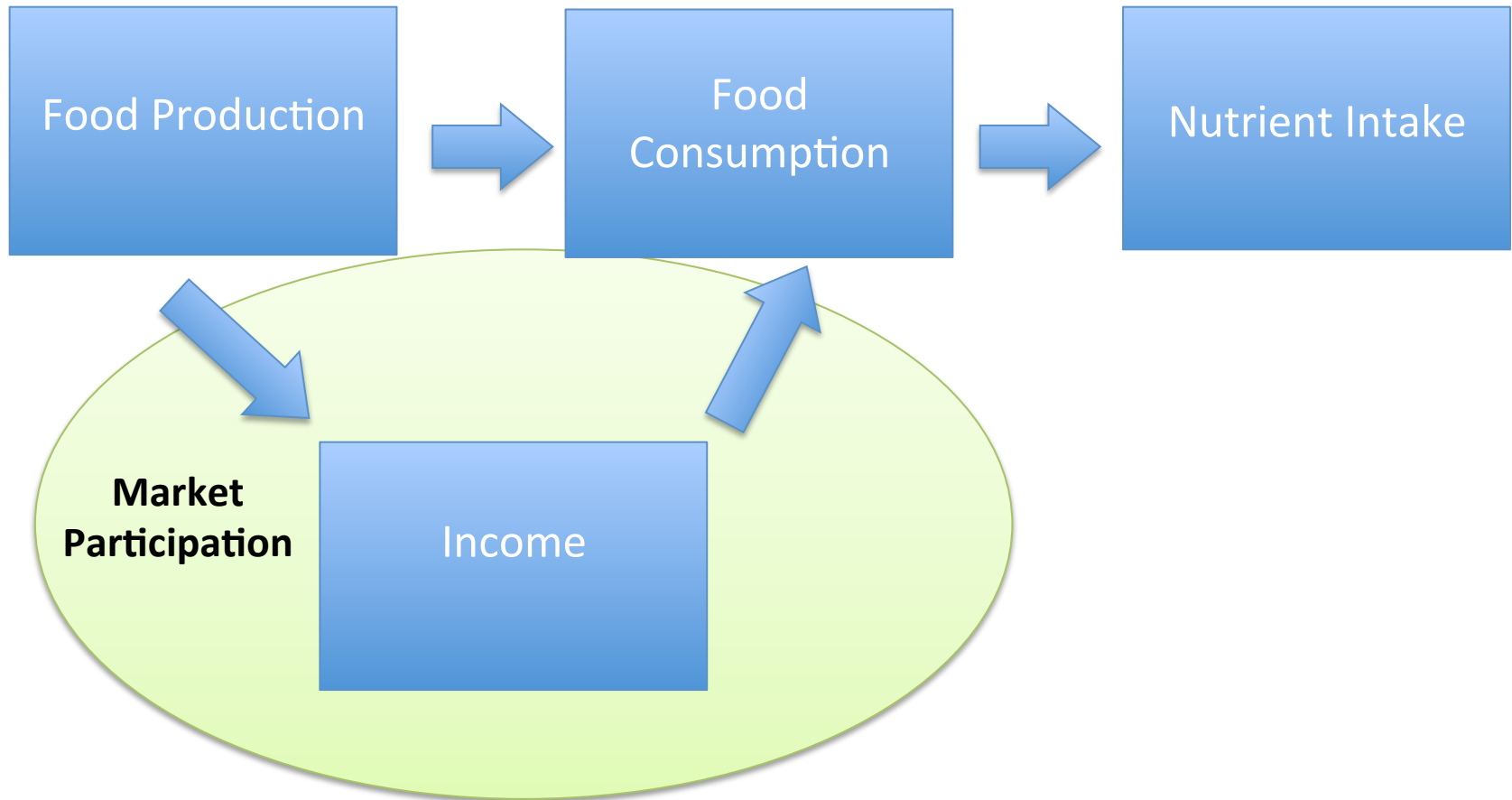
FOOD & RESOURCE  
ECONOMICS  
DEPARTMENT

# MODELING MARKET PARTICIPATION AND NUTRIENT DEMAND AMONG AGRICULTURAL HOUSEHOLDS IN BANGLADESH

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# Agriculture, Nutrition, and Markets



# Agricultural Household Model with Health, Nutrition, and Market Participation

$$\text{Max } U = U(H(\cdot), C(\cdot), \ell, \mu)$$

$$\text{s.t. } F_j = F_j(X, L_f) \quad \forall j$$

$$T = L_f + L_w + \ell$$

$$\sum_{j=1}^J I_j^B q_j M_j = \sum_{j=1}^J I_j^S p_j M_j + wL_w - X'p_x$$

# Model Continued

$$\mathcal{L} = U(C, H, \ell, \mu) + \lambda \left[ I_j^S p_j M_j + w L_w - X' p_x - I_j^B q_j M_j \right]$$

N = Nutrients  
(carbohydrates, fats,  
proteins, vitamins,  
minerals)

where  $H = H(C(.), \eta)$

$$C_j = C_j(N, \alpha) \quad \forall j$$

$\alpha$  = Other attributes

$$I_j^\gamma = \begin{cases} I_j^B = 1 \text{ if } (F_j - C_j) < 0, 0 \text{ otherwise} \\ I_j^S = 1 \text{ if } (F_j - C_j) > 0, 0 \text{ otherwise} \\ I_j^A = 1 \text{ if } (F_j - C_j) = 0, 0 \text{ otherwise} \end{cases} \quad \forall j$$

$$M_j = F_j - C_j$$

$$(q_j - p_j) = \tau_j(A, G, W, M_j, V, \Omega)$$

# Theoretical Contribution

- Agricultural household utility is a function of:
  - Goods and leisure consumed by the household
    - Produced at home or purchased in the market
  - Health of household members
    - Nutrition is an input to health, delivered through the goods consumed
- Market participation influences the consumption of nutrients
  - Ability to access to markets
  - Price volatility and transaction costs

# Empirical Question

- How does participation in markets for buying and selling food products affect household consumption of nutrients?
  - Household demand for nutrients such as protein, vitamin A, and iron is a function of market participation, household and farm characteristics
  - Assume production decisions are exogenous to consumption
- FAO/WFP food group classification as a proxy for nutrients



# Food Groups (WFP 7 day food frequency)



- Vegetables
  - Orange vegetables (vitamin A)
  - Leafy green vegetables
  - Tropical fruits (vitamin A)
  - Fruits
  - Meat
  - Eggs
  - Milk and milk products
- How many days, in the last 7 days has someone in your household consumed [food group]?

# Methodology

- Double Hurdle Models (Logit – Poisson)
- Two stage decision, allowing for zero outcome in each stage
  - First stage: decision to participate in markets [0/1]
    - Markets for buying food
    - Markets for selling food
  - Second stage: number of days a food group was consumed [0,7]
    - Accounts for non-participation due to choice or random circumstance
- Independent variables: district, religion, gender, age, and education of household head, household size, land holdings

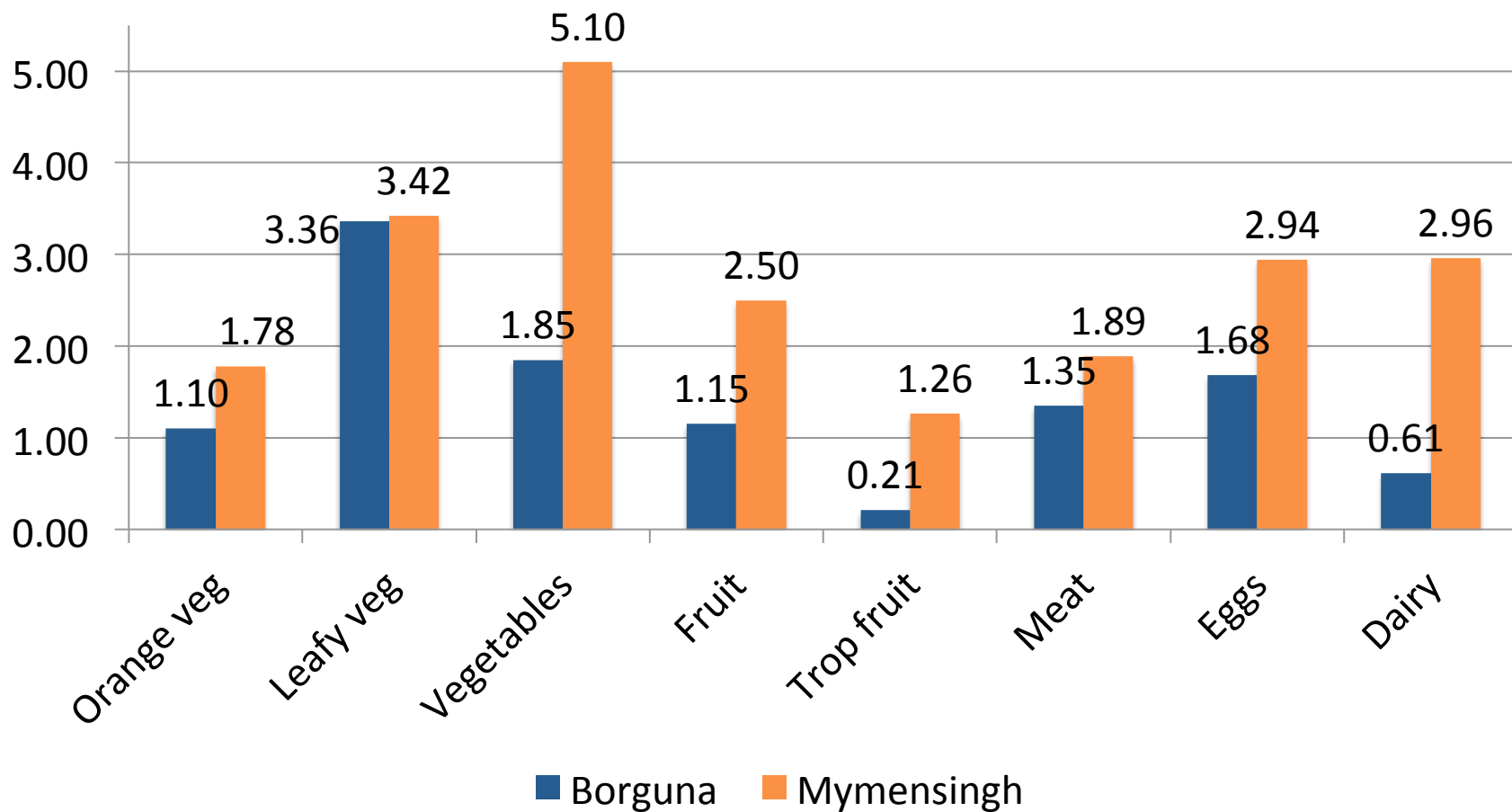
# Data

- Household survey data (n = 1,130)
  - Agricultural production
  - Market participation
  - Dietary diversity (7 day food frequency)
  - Household member demographics
- Two districts of Bangladesh
  - 52% Mymensingh (North-central)
  - 48% Borguna (South)

## Summary Statistics, Covariates by District

Variable	All	Borguna	Mymensingh
Religion (Muslim = 1)	0.95	0.92	0.99
Male-headed household	0.85	0.75	0.94
Household head education primary school	0.33	0.44	0.24
Household head education junior secondary school	0.11	0.06	0.15
Household head education secondary school	0.06	0.02	0.10
Household head education SSC pass	0.05	0.01	0.10
Household head education postsecondary school	0.07	0.00	0.12
Age of household head	45.14	44.53	45.69
Household size	4.62	4.13	5.07
Total ag land (decimals)	72.88	49.39	94.23
Buy food at the market	0.40	0.62	0.21
Sell food at the market	0.47	0.30	0.63

# Mean Household 7 Day Consumption of Select Food Groups by District



## Results: Factors that Affect Participation in Buyers' Markets (Logit)

Variable	Orange Veggies	Leafy Veggies	Vegs	Fruit	Tropical fruit
Constant	1.03	4.13E+07	1.88	1.00	0.09***
Buy food at the market	0.81	0.82	2.87***	1.11	1.35
District (Mymensingh = 1)	5.72***	1.87	178.64***	21.60***	36.50***
Religion (Muslim = 1)	0.44***	7.11E-07	0.99	1.16	0.41**
Male-headed household	1.67***	1.27	0.98	0.82	1.02
Household head education primary school	1.02	0.33***	0.57***	0.85	1.43*
Household head education junior secondary school	1.45	9.14E+05	0.60	1.51	1.48
Household head education secondary school	0.99	0.92	0.79	0.95	0.67
Household head education SSC pass	0.97	8.66E+05	0.39	1.17	0.74
Household head education postsecondary school	1.13	0.52	1.07	1.84	1.45
Age of household head	1.00	0.99	0.98**	1.00	1.00
Household size	0.95	1.12	0.92	0.94	1.06
Total ag land (decimals)	0.82	0.99	1.00	1.00***	1.00
Number of observations	1,127	1,128	1,125	1,125	1,120
Log Likelihood	-1695	-2091	-2151	-1791	-1038

## Results: Factors that Affect Consumption Among Participants in Buyers' Markets (Poisson)

Variable	Orange Veggies	Leafy Veggies	Vegs	Fruit	Tropical fruit
Constant	3.83***	4.06	2.77	2.88***	2.02**
Buy food at the market	0.84**	0.93*	1.22***	0.90*	0.82*
District (Mymensingh = 1)	0.66***	0.96	1.68***	0.75***	0.55***
Religion (Muslim = 1)	0.93	0.94	1.21*	1.10	0.74
Male-headed household	1.14	0.94	1.01	0.87*	0.65***
Household head education primary school	0.88*	0.95	0.97	1.03	1.23
Household head education junior secondary school	0.81**	0.94	0.99	1.19**	1.40**
Household head education secondary school	1.04	1.09	1.00	1.33***	1.49**
Household head education SSC pass	0.94	1.03	1.17**	1.33***	1.37
Household head education postsecondary school	0.77**	1.08	0.99	1.17*	1.75***
Age of household head	1.00	1.00	1.00	11.00	1.00
Household size	0.96**	0.99	1.00	0.99	1.05*
Total ag land (decimals)	1.00***	1.00	1.00*	1.00*	1.00*
Number of observations	1,127	1,128	1,125	1,125	1,120
Log Likelihood	-1695	-2091	-2151	-1791	-1038

## Results: Factors that Affect Participation in Buyers' Markets (Logit)

Variable	Eggs	Meat	Dairy
Constant	0.75	0.12***	0.06***
Buy food at the market	1.31	1.91***	1.82***
District (Mymensingh = 1)	6.53	17.69***	45.62***
Religion (Muslim = 1)	1.69*	3.97***	1.51
Male-headed household	1.28	1.41*	0.87
Household head education primary school	0.85	1.26	1.36
Household head education junior secondary school	1.09	1.59	1.34
Household head education secondary school	1.15	1.55	0.85
Household head education SSC pass	1.23	1.81	1.01
Household head education postsecondary school	1.30	2.48	3.99***
Age of household head	1.00	1.00	1.00
Household size	1.07	1.06	0.95
Total ag land (decimals)	1.00	1.00	1.00
Number of observations	1,126	1,128	1,120
Log Likelihood	-1993	-1680	-1752



## Results: Factors that Affect Consumption Among Participants in Buyers' Markets (Poisson)

Variable	Eggs	Meat	Dairy
Constant	2.72***	0.67	2.85***
Buy food at the market	1.11**	0.94	0.92
District (Mymensingh = 1)	1.35***	0.67***	0.80***
Religion (Muslim = 1)	1.01	3.30***	1.14
Male-headed household	0.89	0.89	1.00
Household head education primary school	1.06	1.03	1.10
Household head education junior secondary school	1.05	1.21*	1.09
Household head education secondary school	1.08	1.19	1.28***
Household head education SSC pass	1.24**	1.34**	1.18*
Household head education postsecondary school	1.33***	1.28**	1.11
Age of household head	0.99***	1.00	1.00
Household size	0.99	1.00	1.00
Total ag land (decimals)	1.00	1.00	1.00***
Number of observations	1,126	1,128	1,120
Log Likelihood	-1993	-1680	-1752

# Summary of Results

- Results show a lower consumption rate of vitamin-rich vegetables and fruits among households who participate in markets for buying foods
  - Higher consumption rate for “other” vegetables and eggs
- District is a significant predictor of market participation
  - Need to further explore the factors at play here

# Further Analysis

- Comparison of models
  - Double hurdle model assumes two-stage sequential decision
  - Bellemare and Barrett (2006) show market participation for livestock sale is a simultaneous decision
- Analyze trade-offs between consuming own production vs. selling nutrient-rich foods
  - Are households selling eggs and mangos to purchase more rice?